



October 2, 2003

DESIGN MEMORANDUM No. 03-16
TECHNICAL ADVISORY

TO: All Design, Operations, and District Personnel, and Consultants

FROM: /s/ Anthony L. Uremovich
Anthony L. Uremovich
Design Policy Engineer
Contracts and Construction Division

SUBJECT: Pavement Milling

COMPLEMENTS: *Indiana Design Manual Section 52-7.0*

SUPERSEDES: *Indiana Design Manual Section 56-4.04(09)*

EFFECTIVE: October 21, 2003, Letting

The new design requirements for each type of pavement milling work are as follows.

I. Additions to *Indiana Design Manual* Chapter Fifty-two

Section 52-7.05 is a new section to be added as follows.

52-7.05 Milling of Pavements

An asphalt or concrete pavement may be milled to remove distressed layers or material, make crown corrections, maintain curb heights or vertical clearances, scarify existing surfaces, profile existing surfaces, remove asphalt overlays, or provide pavement transitions in accordance with Recurring Special Provision 306-R-463, attached hereto. The five types of milling of pavements and their general usages are as follows.

1. Asphalt milling is used to remove distresses near the surface of the pavement or is used prior to placing an HMA inlay.
2. Asphalt scarification/profile milling is used to roughen the surface or remove excessive crack sealant prior to placing an HMA overlay.
3. Asphalt removal is used to remove asphalt materials down to a concrete or brick base.
4. Concrete pavement milling is used to roughen the existing surface or to provide crown corrections prior to placing an overlay.
5. Transition milling is used to provide transitions to adjoining sections.

For projects with pavement designs as recommended by the Materials and Tests Division's pavement design engineer, the milling types, limits, and average depths will be included in the pavement design.

For other projects, milling types, limits, and average depths will be determined by the designer. The designer should contact the district testing section to request that pavement cores be taken and the core analyses be transmitted to the designer. The designer can use the analysis information to determine required milling depths. If milling is proposed near a signalized intersection, the designer should coordinate with the district traffic section to either avoid or replace existing signal loops.

52-7.05(01) Asphalt Milling

Asphalt milling is intended to remove material from an existing pavement to a specified average depth by milling the surface and creating a uniform profile. Milling of asphalt pavement may be used to adjust roadway cross section, develop or maintain curb exposure, remove wheel ruts, tie the new pavement into existing pavement, improve drainage, or remove undesirable areas or layers of pavement. Existing layers of HMA Surface Sand on or near the surface should be removed. Asphalt milling is used as follows:

1. prior to placing an HMA inlay;
2. prior to placing a partial 3R preventative maintenance treatment;
3. removal of stripped or distressed asphalt;
4. correction of substandard cross slope or crown conditions;
5. making profile corrections; or
6. maintaining vertical clearances or curb heights.

An average depth of milling should be specified depending on the condition of the pavement or project requirements.

The average milling depth specified will be sufficient to accommodate an HMA inlay or the removal of distressed materials. For a partial 3R preventative maintenance treatment, the milling depth should equal the new pavement thickness. The average milling depth to be used will be 25, 38, 50, 75, or 100 mm (1 in., 1½ in., 2 in., 3 in., or 4 in.).

For variable milling depths to correct cross slope deficiencies, the limits and associated milling depths must be shown on the typical cross sections on the plans in accordance with Section 52-13.0.

52-7.05(02) Asphalt Scarification/Profile Milling

Asphalt scarification/profile milling is used to provide a roughened texture to an existing surface. Asphalt scarification/profile milling will remove crack sealant to prevent slippage of the overlay materials, roughen the existing surface that has polished due to traffic, or correct minor profile or cross slope deficiencies. Correction of minor cross-slope deficiencies is limited to 5 mm average rut depth as determined by the INDOT pavement management system. Milling operations to correct pavement conditions that require deeper milling should be in accordance with Section 52-7.05(01).

Asphalt scarification/profile milling is used to prepare an existing pavement for a single-course HMA overlay. Asphalt scarification/profile milling is be used to prepare an existing pavement for a functional overlay where the existing pavement has excessive crack sealant or requires minor profile corrections.

52-7.05(03) Asphalt Removal

Asphalt removal milling is used to remove an entire asphalt overlay from a concrete or brick base. The designer will show the approximate existing asphalt thickness on the typical cross sections on the plans.

52-7.05(04) Concrete Pavement Milling

Concrete pavement milling is intended to remove materials from existing concrete pavement to a specified average depth by milling the surface and creating a uniform profile. An average depth of milling should be specified depending on the condition of the pavement or project requirements. Concrete pavement milling is used as follows:

1. correction of substandard cross slope or crown conditions;
2. profile corrections; or
3. maintaining vertical clearances or curb heights.

The designer will designate the average milling depth on the typical cross sections on the plans. For variable milling depths to correct cross slope deficiencies, the limits and associated milling depths must be shown on the typical cross sections on the plans in accordance with Section 52-13.0.

52-7.05(05) Transition Milling

Transition milling is used to provide a connection between an HMA overlay and an adjoining pavement, driveway, paving exception, or public road approach. The transition slope and notch depth in the existing asphalt or concrete pavement will be in accordance with the INDOT *Standard Drawings*.

52-7.05(06) Disposal of Milled Material

Recurring Special Provision 306-R-463 states that milled material is to become the property of the contractor. The designer should contact the appropriate operations field engineer or subdistrict manager to determine if the Department wants to retain some or all of the milled material. If so, the operations field engineer or subdistrict manager will specify the quantity of milled material to be delivered to a predetermined location. The designer should include arrangements regarding such milled material in the special provisions.

II. Revisions to *Indiana Design Manual* Chapter Fifty-six

Section 56-4.04(09) has been superseded by a new version of the section as follows.

56-4.04(09) Pavement Milling

Pavement milling should be considered as described in Section 52-7.05.

III. Pay Items

New Recurring Special Provision 306-R-463 should be called for if milling is required. The code numbers and pay items are listed below. The pay unit for all items is square meter (square yard).

Code No.	Pay Item
306-08033	Milling, Asphalt, 25 mm Milling, Asphalt, 1 in.
306-08034	Milling, Asphalt, 38 mm Milling, Asphalt, 1½ in.
306-08036	Milling, Asphalt, 50 mm Milling, Asphalt, 2 in.
306-08037	Milling, Asphalt, 75 mm Milling, Asphalt, 3 in.
306-08038	Milling, Asphalt, 100 mm Milling, Asphalt, 4 in.
306-08039	Milling, Asphalt Removal
306-08041	Milling, Concrete Pavement
306-08042	Milling, Scarification/Profile
306-08043	Milling, Transition

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Attachment

MILLING

The Standard Specifications are revised as follows:

SECTION 202, BEGIN LINE 174, DELETE AND INSERT AS FOLLOWS:

202.05 Removal of Pavement PCCP, Sidewalks, Curbs, Surface, Surface Milling, etc. All concrete pavement PCCP, base course, sidewalks, curbs, gutters, etc., designated for removal shall be:

- (a) broken into pieces and used for riprap on the project; *or*
- (b) broken into pieces, the maximum weight of which shall be 68 kg (150 lb), and incorporated into the work as directed; or
- (c) otherwise disposed of in accordance with 202.02.

~~Removal of pavement~~ *Pavement removal* shall consist of the removal and satisfactory disposal of ~~portland cement concrete pavement PCCP; portland cement concrete PCC~~ resurface with its base; or the total of any combination of HMA base, intermediate, and surface course of any pavement on a portland cement concrete base, including the base. ~~Each complete pavement removed will be considered as a separate item and paid for as such when removed.~~ Pavement removal shall include only the removal and disposal of existing public road, street, and alley pavement as required for the planned construction. Curb removal shall include curb that is separate from the pavement or removed separately. Integral curb that is removed with the adjacent pavement shall be paid for as pavement removal. Prior to performing the work of pavement removal at locations shown on the plans or where directed, cement concrete pavement to be removed shall be cut with a power driven concrete saw along designated lines. Sawing shall be such that any portion of the pavement to remain in place will not be damaged. Any portion that is damaged or removed outside the designated lines shall be replaced with no additional payment. Sawing of pavement to be removed will not be paid for directly, but shall be included in the cost of pavement removal.

SECTION 202, DELETE LINES 201 THROUGH 247:

SECTION 202, BEGIN LINE 533, DELETE AND INSERT AS FOLLOWS:

~~Surface removal will be measured by the square meter (square yard) of the area removed.~~

~~Surface milling, asphalt; and surface milling, portland cement concrete will be measured by the square meter (square yard) of the milled area.~~

Pavement removal will be measured by the square meter (square yard) of the area removed.

SECTION 202, BEGIN LINE 605, DELETE AND INSERT AS FOLLOWS:

~~Surface milling will be paid for at the contract unit price per square meter (square yard) for surface milling, asphalt; or surface milling, portland cement concrete.~~

~~Removal of surface will be paid for at the contract unit price per square meter (square yard) for surface, remove.~~

Pavement removal will be paid for at the contract unit price per square meter (square yard).

If there is no pay item for pavement removal and such is encountered, payment will be made for each square meter (square yard) removed. Such pavement removal shall apply only to portland cement concrete pavement or base. A unit price for this work will be established based on thickness, quantity, and removal process. Such unit price will be generated prior to the work being performed. If portland cement concrete pavement has an asphalt overlay, its removal will be considered as incidental, for which no direct payment will be made.

SECTION 202, AFTER LINE 625, INSERT AS FOLLOWS:

Pavement Removal.....m2 (SYS)

SECTION 202, BEGIN LINE 648, DELETE AS FOLLOWS:

~~*Surface Milling, Asphalt.....m2 (SYS)*~~

~~*Surface Milling, Portland Cement Concrete.....m2 (SYS)*~~

~~*Surface, Remove.....m2 (SYS)*~~

SECTION 202, BEGIN LINE 771, DELETE AS FOLLOWS:

~~*The costs of milling material and the removal of such material from the project site shall be included in the cost of surface milling.*~~

SECTION 306, BEGIN LINE 1, DELETE AND INSERT AS FOLLOWS:

SECTION 306 –~~Blank~~ MILLING

306.01 Description. *This work shall consist of the milling of asphalt and concrete pavements and the disposal of milled materials.*

CONSTRUCTION REQUIREMENTS

306.02 General. *Milling operations shall be described in the QCP in accordance with ITM 803. Where the milling operation in a partial-day closure results in a vertical or near vertical face exceeding 38 mm (1.5 in.) in height, the adjacent lane shall be milled during the same day, the milled lane resurfaced during the same day, or the vertical face tapered at a 45 deg angle or flatter. Where located within 75 mm (3 in.) of a curb, surface material that cannot be removed by the cold-milling machine shall be removed by other approved methods.*

Transverse milled vertical faces greater than 25 mm (1 in.) that are exposed to traffic shall be transitioned in an approved manner.

Castings located in milling areas that are not to be adjusted may remain in place during the milling, or may be removed and replaced at the Contractor's option.

Localized weak areas uncovered by the milling process shall be patched in accordance with 304 or 305.

The milled material shall become the property of the Contractor, unless otherwise specified.

The roadway shall be cleaned before opening to traffic.

306.03 Equipment. *Equipment for milling shall be in accordance with the following.*

(a) Roadway Milling Machine. *A milling machine shall be a power operated cold-milling machine, equipped with automatic control devices to establish profile grades by referencing from either the existing pavement or from independent grade control. The equipment shall have a positive means of controlling cross slope elevations, have an effective means for removing excess material from the surface, preventing airborne dust escaping from the operation, and producing a finished surface that provides a good bond to the new overlay. Sufficient cutting teeth shall be on the cutting drum to produce cuttings such that 90% of the conglomerate particles pass a 50 mm (2 in.) sieve.*

(b) Power Saw. *Sawing equipment shall be capable of maintaining the specified alignment and depth of cut without damaging the pavement.*

(c) Rotary Power Broom. *A motorized, pneumatic tired unit with rotary bristle broom head.*

(d) Straightedge.

1. Straightedge – 4.9 m (16 ft). *A 4.9 m (16 ft) straightedge shall be a rigid beam mounted on two solid wheels on axles 4.875 m (16 ft) apart. The straightedge has a mounted push bar to facilitate propelling the device along or across the pavement. Tolerance points are located at the 1/4, 1/2, and 3/4 points and may be composed of threaded bolts capable of being adjusted to the tolerance required.*

2. Straightedge – 3 m (10 ft). *A 3 m (10 ft) straightedge is the same as a 4.9 m straightedge except that the wheels are mounted 3.048 m (10 ft) apart. A handheld rigid beam may be substituted.*

306.04 Asphalt Scarification and Profile Preparation. *Asphalt scarification and profile preparation shall consist of preparing a base for resurfacing by removing existing asphalt material. The entire existing asphalt surface shall be roughened by the operations. The existing pavement shall be milled to the cross-slope as shown on the plans, and shall have a surface finish that does not vary longitudinally more than 6 mm (1/4 in.) from a 4.9 m (16 ft) straightedge or as described in the QCP in accordance with 401.02. The milled surface shall have macrotexture equal to or greater than 2.2 for single course overlays and 1.8 for multiple course overlays in accordance with ITM 812. Frequency of macrotexture testing shall be a minimum of once per day and shall be described in the QCP. The cross-slope shall not vary more than 3 mm (1/8 in.) when measured with a 3 m (10 ft) straightedge.*

Milled mainline areas left open to traffic for longer than 5 work days will be assessed \$1000.00 per day per lane kilometer (\$1600.00 per day per lane mile), or

portion thereof, as liquidated damages, not as a penalty, but as damages sustained for each work day that the milled area remains open to traffic.

306.05 Asphalt Milling. Asphalt milling shall consist of preparing a base for resurfacing by removing the existing asphalt material at a specified average depth. The existing pavement shall be milled to the cross-slope as shown on the plans, and shall have a surface finish that does not vary longitudinally more than 6 mm (1/4 in.) from a 4.9 m (16 ft) straightedge or as described in the QCP in accordance with 401.02. The milled surface shall have macrotexture equal to or greater than 2.2 for single course overlays and 1.8 for multiple course overlays in accordance with ITM 812. Frequency of macrotexture testing shall be a minimum of once per day and shall be described in the QCP. The cross-slope shall not vary more than 3 mm (1/8 in.) when measured with a 3 m (10 ft) straightedge.

If shoulders or turn lanes are not milled and the overlay material is not placed in the milled areas within the same day, drainage slots shall be provided to eliminate ponding of water.

Milled mainline areas left open to traffic for longer than 5 work days will be assessed \$1000.00 per day per lane kilometer (\$1600.00 per day per lane mile), or portion thereof, as liquidated damages, not as a penalty, but as damages sustained for each work day that the milled area remains open to traffic.

306.06 Asphalt Removal. Asphalt removal shall consist of complete removal of asphalt by milling from a portland cement concrete or brick base and the satisfactory disposal of the milled materials. Minor amounts of asphalt pavement material bonded to a concrete base at joints or cracks may remain in place. If this material becomes displaced during subsequent operations it shall be removed. Minor amounts of asphalt pavement material bonded to a brick base may remain in place. Removal of minor areas of portland cement concrete or brick base during the milling operations is acceptable.

Milled areas shall be cleaned prior to reopening to traffic or before continuing construction operations.

306.07 PCCP Milling. PCCP milling shall consist of preparing a base for resurfacing by removing the existing PCCP material at a specified average depth. The existing pavement shall be milled to the cross-slope as specified in the plans, and shall have a surface finish that does not vary longitudinally more than 6 mm (1/4 in.) from a 4.9 m (16 ft) straightedge or as described in the QCP in accordance with 401.02. The milled surface shall have macrotexture equal to or greater than 1.8 in accordance with ITM 812. Frequency of macrotexture testing shall be a minimum of once per day and shall be described in the QCP. The cross-slope shall not vary more than 3 mm (1/8 in.) when measured with a 3 m (10 ft) straightedge or as directed by the Engineer.

A milled surface shall not be left open to traffic for longer than 14 calendar days. If the milled surface is not overlaid after 14 calendar days, \$1000.00 per day per lane kilometer (\$1600.00 per day per lane mile), or portion thereof, will be assessed as liquidated damages, not as a penalty, but as damages sustained for each calendar day that the milled area remains left open to traffic.

306.08 Transition Milling. Transition milling shall consist of cutting a wedge at the beginning and ending of projects, drives, paving exceptions and public road approaches. The existing pavement shall be cut to provide a vertical face of 38 mm (1.5 in.) for the termini of each overlay lift of base, intermediate, or surface. The existing pavement shall be milled at a rate of 60:1 or as directed to achieve the specified cut where the pavement transition overlay lifts differ from cut depth. Pavement transitions for driveways and public road approaches will only be cut for the surface course.

Automatic control devices will not be required on surface milling equipment used for transitions cut off the mainline. Cutting shall not damage any pavement that is to remain in place.

306.09 Method of Measurement. Asphalt milling, asphalt removal, PCCP milling, scarification/profile milling, and transition milling will be measured by the square meter (square yard) of the milled area.

306.10 Basis of Payment. Asphalt milling, asphalt removal, PCCP milling, scarification and profile milling, and transition milling will be paid for at the contract unit price per square meter (square yard).

Payment will be made under:

<i>Pay Item</i>	<i>Pay Unit Symbol</i>
Milling, Asphalt, _____ mm..... thickness	m2
(Milling, Asphalt, _____ in. thickness	SYS)
Milling, Asphalt Removal.....	m2 (SYS)
Milling, PCCP.....	m2 (SYS)
Milling, Scarification/Profile	m2 (SYS)
Milling, Transition	m2 (SYS)

The cost for castings removed and replaced at the Contractor's option in accordance with 306.02 shall be included in the cost of the milling.

Any portion of the pavement that is damaged or removed outside the milling limits shall be replaced with no additional payment.

The cost of tapering of vertical faces and removal of milled material from the project site shall be included in the cost of milling.

The cost of cutting of the surface course shall be included in the milling.